

## REMARKS

Applicants have amended claims 1, 32, 40, and 46-49. The Examiner's comments and rejections are addressed below.

### **The 35 U.S.C. § 112 Rejections**

The Examiner rejected claims 1, 40, and 46 under 35 U.S.C. § 112, first paragraph for not complying with the written description requirement. Specifically, the Examiner thought that there was "insufficient support in the disclosure as originally filed about a composition lacking sugar and/or sugar alcohol," in which claims 1, 40, and 46 describe. However, Applicants respectfully traverse these rejections, in light of the amendments.

Claims 1 and 40 have been amended to recite a composition for removal of etch residues from integrated circuits using copper materials and low k dielectric materials. Support for these amended claims can be found within the specification. For example, the specification provides that there is a need to develop new cleaning chemistries and processes that are compatible with copper and low k dielectric materials because the recently developed interconnects use copper and low k dielectric materials (page 1, lines 13-19 and 31-33). The specification further describes that the present invention is aimed at "cleaning residues left after etching dielectric material and openings on a copper layer." (Page 2, lines 31-32). Thus, the chemistry recited in the present invention is designed to be compatible with both copper and low-k dielectric materials (page 4, lines 33-34 and page 16, lines 33-34), such as SiLK, an organic low k dielectric (page 18, line 26).

Additionally, claim 46 has been amended to recite a composition for the removal of etch residues consisting of a choline compound, water, and an organic solvent. With this change, the composition of claim 46 is now only limited to a choline compound, water, and an organic solvent, which is amply supported in the specification, as described, for example, in the experiments on pages 18-19.

In light of the above, Applicants respectfully request withdrawal of the § 112 ¶ 1 rejections to claims 1, 40, and 46.

### The 35 U.S.C. § 103 (a) Rejections

The Examiner rejected claims 1-9 and 32-49 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,846,695 ("Iwata") in view of U.S. Patent No. 5,798,323 ("Honda"). Applicants respectfully traverse these rejections, in light of the amendments.

When rejecting claims under 35 U.S.C. § 103(a), the examiner bears the burden of establishing a *prima facie* case of obviousness. Three criteria are required to establish a *prima facie* case of obviousness. First, the prior art reference, or references when combined, must teach or suggest each and every limitation of the claimed invention. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the teachings of the references in the manner suggested by the examiner. Finally, the skilled artisan, in light of the teachings of the prior art, must have a reasonable expectation that the modification or combination suggested by the examiner would be successful. *See, In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). Both the teaching or suggestion to make the claimed invention and the reasonable expectation of success must be found in the prior art, not in the Applicant's disclosure. If any one of these criteria is not met, *prima facie* obviousness has not been established.

Based on the above test, the Examiner has not established a *prima facie* case of obviousness because there is no motivation to combine Iwata with Honda. Iwata teaches a composition for removal of etch residues from a semiconductor integrated circuit surface using copper materials which comprises a 0.01 to 20 percent by weight of a quaternary ammonium hydroxide, 1 to 80 percent by weight of a nucleophilic amine, which includes hydroxylamine, and 0.5 to 20 percent by weight of sugar or sugar alcohol (col. 3, line 18-col.4, line 31). Honda teaches a composition comprising 5 to 50 percent by weight of a solvent, including dimethyl sulfoxide and propylene glycol, 10 to 90 percent by weight of an alkanolamine, 0.1 to 4 percent by weight of a corrosion inhibitor, and 0.1 to 40 percent by weight of water (column 4, line 39 - column 5, line 3).

However, Honda explicitly teaches away from the use of quaternary ammonium hydroxide (*e.g.*, TMAH) because of particular disadvantages associated with such use and teaches not to use any quaternary ammonium hydroxide compound due to these disadvantages. More specifically, Honda discloses that compositions containing tetramethylammonium hydroxide (TMAH), a quaternary ammonium hydroxide, attack aluminum, thereby etching away an aluminum oxide residue (column 1, lines 63-65), and is

ineffective on residues from polysilicon plasma etch processes (column 2, lines 2-3); limiting aluminum corrosion and effectively removing residues are two goals of the Honda invention. Furthermore, Honda also teaches away from the use of hydroxylamine in stripping compositions, especially when used under high temperatures or in a highly alkaline medium (col. 2, lines 11-24). Based on the foregoing, there is no motivation or suggestion to combine Iwata with Honda because of Honda's disavowal of the use of TMAH, a quaternary ammonium hydroxide, and hydroxylamine, in which both compounds are deemed to be essential elements in Iwata based on their potentially significant weight contribution to Iwata's composition. Therefore, it is highly unlikely for persons of ordinary skill in the art to be motivated to combine these references at all. Moreover, based on the statements in Honda, one of skill in the art would not have a reasonable expectation of success by combining Honda with Iwata. Indeed, Honda teaches away from using two of the four components in Iwata because TMAH is ineffective in removing residues from copper materials (Al/ Si/ Cu) and "also is ineffective on residues from polysilicon plasma etch process." (Honda, col. 1, line 65 - col.2, line 3). Furthermore, TMAH will promote corrosion of aluminum (col. 1, lines 60-65) and hydroxylamine is "not suitable" in the high temperature and alkaline compositions of Honda. Where the goal is to effectively remove residues that are likely to contain silicon and limit corrosion, one of skill in the art would be taught away from combining Honda and Iwata because Honda teaches the combination that would cause aluminum corrosion and result in ineffective silicon etch residue removal.

With respect to Examiner's comment that it would have been obvious to omit sugar or sugar alcohol because Iwata does "not teach that the invention would not be inoperable," Examiner's comment is obviated by considering that one of skill in the art would not have been motivated to combine Iwata and Honda in the first place. The Examiner essentially suggests simply discarding the sugar and/or sugar alcohol component of Iwata contrary to the teachings therein. However, there is not a single example in Iwata with a quaternary ammonium hydroxide amount greater than 15% by weight and no other teaching or suggestion one way or the other on what effect would result by discarding that component. Accordingly, there is no teaching regarding any formulation with greater than 20% of a choline compound regardless of whether the sugar alcohol is included or not. Furthermore, one of skill in the art would have no idea how sugar and/or sugar alcohol would affect a dielectric material, as recited in amended independent claims 1, 32, and 40. For instance, available references such as Iwata do not disclose whether sugar and/or sugar alcohol would

affect a dielectric material, which indicates that one of skill in the art would not know the effects of sugar and/or sugar alcohol. Without knowing the effects of sugar and/or sugar alcohol, it would not occur to one of skill in the art to combine Iwata and Honda. Therefore, Examiner cannot automatically conclude obviousness based on this point.

With respect to obviousness based on the alleged closeness of the choline weight percentages recited in Iwata and the present invention, Applicants respectfully point out that Iwata teaches that the concentration of quaternary ammonium hydroxide cannot exceed the specified range, *i.e.*, 20 percent by weight, because corrosion of the wiring material in the circuit cannot be prevented (column 3, lines 35-46), while claims 32-39 and 43 of the present invention teaches the use of choline exceeding 20 percent by weight, specifically 20 to 50 percent by weight. As one can see, the present invention contradicts the teachings of Iwata. The teachings of Iwata would not function as intended, *i.e.*, to prevent corrosion while stripping etch residues, with the higher concentration of choline as taught by the present invention. Thus, Iwata emphatically teaches away from the invention of claims 32-39 and 43, as well as not teaching the same limitations in the present invention. Furthermore, the shortcomings of Iwata when using choline at concentrations exceeding 20 percent by weight are not cured by Honda, which disfavors the use of TMAH and any other quaternary ammonium hydroxide such as choline.

As to the Examiner's assertion that *prima facie* obviousness exists when "the claimed ranges overlap or lie inside ranges disclosed by the prior art," with respect to the organic solvent and water content used in the present invention, it is not relevant in this case because persons of ordinary skill in the art would not have been motivated to combine Iwata and Honda in the first place, as discussed earlier. If there is no motivation to combine these references in the first place, then there is no overlapping range or obviousness issue to contend with.

With respect to claims 8, 38, and 48, the Examiner asserts that the combined teachings of Iwata and Honda provide for a composition that additionally comprises hydroxylamine. This completely disregards the fact that Honda teaches away from using hydroxylamine. In fact, the claimed invention of Honda expressly recites a "composition which is free of hydroxylamine." Especially with respect to claims 8, 38, and 48, one skill in the art would not combine Iwata and Honda. Similar to the above, the use of hydroxylamine in Iwata is irrelevant to show obviousness, regardless if the compositional ranges overlap,

because persons of ordinary skill in the art would not have been motivated to combine Iwata and Honda.

As for claims 9, 39, 44, and 49, the Examiner also suggests that the combined teachings of Iwata and Honda make these claims obvious at the time the invention was made to include a corrosion inhibitor. However, this rejection is also obviated because persons of ordinary skill in the art would not have been motivated to combine Iwata and Honda for the reasons detailed herein.

Based on the foregoing, Applicants respectfully request withdrawal of the rejections to claims 1-9 and 32-49, for these claims are not obvious under Iwata in view of Honda.

### Conclusion

In light of the above amendments and remarks, the Applicant respectfully requests that the Examiner reconsider this application with a view towards allowance. The Examiner is invited to call the undersigned attorney if a telephone call could help resolve any remaining items.

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Respectfully submitted,

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